

A NEW, SIMPLE THREE-STEP METHOD FOR DETERMINING GESTATIONAL AGE*

*Müyesser Tunçer MD**; Esat Yılğör MD***, Gülşen Erdem MD*****

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In order to recognize high-risk babies and differentiate prematurity from fetal malnutrition, an accurate method for determining gestational age is necessary¹⁻³. This is especially important in developing countries where most births do not take place in institutions: the early transport of high-risk babies to intensive care units could save their lives.

The scoring systems currently in use to determine gestational age are rather difficult and in some cases impossible to apply to seriously ill infants, and may be too complicated for use by midwives and nurses, the most readily available medical personnel in many areas⁴. Because of this neonatologists have tried to develop new methods for the determination of gestational age⁵⁻⁸, simple, reliable, applicable to all infants (sick and well) and easily usable by midwives and nurses as well as doctors.

In the light of the above, a study was designed to produce a new set of neurological and physical characteristics from which gestational age could be easily estimated. The new scoring system was developed over a four-year period following many trials of various criteria in different combinations on large numbers of babies. The new system uses the simplest and most practical steps and involves only eight criteria, including a new one (facial appearance). This paper presents the method itself and the results of a study to test its effectiveness.

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- * From the Neonatology Unit, Hacettepe University Institute of Child Health, Ankara.
 - ** Professor of Pediatrics and Head of the Neonatology Unit, Hacettepe University Institute of Child Health.
 - *** Instructor in Pediatrics, Hacettepe University Institute of Child Health.
 - **** Associate Professor of Pediatrics, Hacettepe University Institute of Child Health.

Material and Methods

220 babies admitted to the intensive care nursery of Hacettepe University whose mothers' last menstrual period was known were included in the study. All babies were evaluated both according to the method presented and according to the Dubowitz method⁴. 100 of the babies were scored by neonatologists (M.T. and G.E.) and the remaining 120 by first- and second-year residents. Fifty of the babies of this second group were also evaluated by nurses who did not know the result obtained by the residents. None of those examining the babies had any information about the obstetric history which could indicate gestational age.

Results of both scores and the date of the last menstrual period were recorded and all results were compared with the Dubowitz method⁴, which, statistically, is the best established method. All examinations for scoring the infants were performed between the infants' first 24 and 30 hours of life.

The birthweight of infants in the study group ranged from 610-3700 grams. The gestational ages ranged from 27 to 41 weeks.

The method is based on two scoring systems, one for five external criteria (Table I) and the other for three neurological criteria (Table II). The scores for each are recorded on the work sheet shown as Table III. The entire process is completed in three steps, as follows:

1. *Observation*: Evaluation of posture, appearance of face and perhaps plantar creases without touching the baby (while isolette is closed).
2. *Touching*: Evaluation of the remaining five criteria which cannot be determined by observation alone. This step can be completed within one minute, after which the isolette is closed.
3. *Calculation*: The scores obtained from the first two steps are inserted in the formula given below:

$$180 + A + B = \text{gestational age in days}$$

where A is the score obtained in Table I, and

B is the score obtained in Table II.

The scores are recorded on the work sheet (Table III). The scores given in Table I (1, 9, 12, 16, 22) are flexible, in that the values assigned to each criterion may fall between the score points given.

Gestational age in days is converted to weeks as shown in Table III.

TABLE I
EXTERNAL CRITERIA OF SIMPLE THREE-STEP METHOD FOR ESTIMATION OF GESTATIONAL AGE

SCORE*	1	9	12	16	22
SKIN TEXTURE	THIN, TRANSPARENT GELATINOUS, RED. MAY HAVE SOME EDEMA OF HANDS AND FEET.	SMOOTH, SLIGHT THICKENING. NO OBVIOUS EDEMA. MAY HAVE SOME PITTING OVER TIBIA.	SMOOTH AND MEDIUM THICKENING, PINK, VISIBLE VEINS POSSIBLE.	SMOOTH AND THICK SKIN, PINK, NORMAL SUBCUTANEOUS FAT TISSUE.	THICK AND SUPERFICIAL CRACKING PARCHMENT-LIKE SKIN. MAY BE PEELING OF HANDS AND FEET. MAY HAVE DIMINISHED SUBCUTANEOUS FAT TISSUE.
EAR : FORM AND FIRMNESS	PINNA FLAT AND SHAPELESS LITTLE OR NO INCURVING OF EDGE, SOFT PINNA, EASILY FOLDED.	INCURVING OF PART OF EDGE OF PINNA, PINNA SOFT AND EASILY FOLDED.	PARTIAL INCURVING OF WHOLE OF UPPER PINNA, CARTILAGE TO EDGE OF PINNA, SLOW RECOIL.	FIRM AND WELL DEFINED. INCURVING OF PINNA. INSTANT RECOIL.	THICK, CARTILAGE, EAR STIFF.
BREAST SIZE AND NIPPLE FORMATION	NO BREAST TISSUE PALPABLE, NIPPLE BARELY VISIBLE, NO AREOLA.	BREAST TISSUE DIAMETER < 0.5 CM. NIPPLE WELL DEFINED, AREOLA SMOOTH AND FLAT, DIAMETER < 0.75 CM.	BREAST TISSUE BOTH SIDES ONE OR BOTH, 0.5 - 1.0 CM. AREOLA STIPPLED. EDGE NOT RAISED, DIAMETER < 0.75 CM.	BREAST TISSUE BOTH SIDES > 1 CM. AREOLA STIPPLED. EDGE RAISED, DIAMETER > 0.75 CM.	
PLANTAR CREASES	NO CREASES.	FAINT RED MARKS OVER ANTERIOR HALF OF SOLE.	DEFINITE RED MARKS OVER ANTERIOR 1/2, INDENTATIONS OVER ANTERIOR 1/3.	INDENTATIONS OVER ANTERIOR 1/2.	DEEP INDENTATIONS OVER MORE THAN ANTERIOR 1/2.
FACIAL APPEARANCE	VERY IMMATURE APPEARANCE WITH FAIRLY PROMINENT EYES.	EYES CLOSED MOST OF THE TIME, PREMATURE DULL FACE APPEARANCE.	EYES OPEN MORE OFTEN, APPEARANCE OF FACE MORE MATURE THAN PREVIOUS STAGE. SOME INDENTATION OF NASOLABIAL SULCUS.	WELL - SHAPED FACE, ALERT WHEN NOT SLEEPING, DEFINITE INDENTATION OF NASOLABIAL SULCUS.	VERY ALERT LOOKING, EYES OPEN MOST OF THE TIME. MAY HAVE SOME WRINKLES ON THE FOREHEAD, DEEPER INDENTATION OF NASOLABIAL SULCUS.

* Intermediate scores can be given.

TABLE II
NEUROLOGICAL CRITERIA OF SIMPLE THREE-STEP METHOD FOR
ESTIMATION OF GESTATIONAL AGE

Days Weeks		SCORE	0	2	4	6	8	
189	27	P O S T U R E	Well infant					
196	28							
203	29		Depressed infant					
210	30							
217	31							
224	32	A R M R E C O I L	Well infant	 180°		 100°-180°	 90°-100°	 < 90°
231	33							
238	34		Depressed infant		 180°		 100°-180°	 90°-100°
245	35							
252	36							
259	37	S C A R F S I G N	Well infant					
266	38							
273	39		Depressed infant					
280	40							
287	41							
294	42							
301	43							

$$\text{Gestational age (days)} = 180 + (A + B)$$

TABLE III
ESTIMATION OF GESTATIONAL AGE BY SIMPLE THREE-STEP METHOD
(WORK SHEET)

External Characteristics

Table I. (A)

	1	9	12	16	22
Skin					
Ear					
Breast and Nipple					
Plantar creases					
Facial appearance					

Total A: _____

Neurological Criteria

Table II. (B)

		0	2	4	6	8
Posture	Well infant					
	Dep. infant					
Arm recoil	Well infant					
	Dep. infant					
Scarf sign	Well infant					
	Dep. infant					

Total B: _____

Name _____
 Hospital Number _____
 Place of birth _____
 (Hospital or city) _____
 LMP _____
 Birth date _____
 Birthweight _____

Gestational age
 (days) = $180 + (A + B)$ _____
 Week _____

Day Week

189	27
196	28
203	29
210	30
217	31
224	32
231	33
238	34
245	35
252	36
259	37
266	38
273	39
280	40
287	41
294	42
301	43

Examined
 by _____
 Signature _____

Results

On the basis of the findings, the effectiveness of the new three-step method was assessed from four standpoints, as follows.

1. Accuracy

As can be seen in Figure 1, a good correlation exists between the gestational age obtained from the last menstrual period (LMP) and that obtained from the simple, three-step method when the examination is carried out by neonatologists. This was significant with a correlation coefficient of $r = 0.945$ (Figure 1a). A good correlation also existed for the residents' scoring of the 120 infants: $r = 0.941$ (Figure 1b). A 95 percent confidence limit (+ one week) was obtained with this method.

There was also a good correlation of results between the present method and the Dubowitz method in the scoring by neonatologists ($r = 0.945$, $r = 0.880$) and by residents ($r = 0.941$, $r = 0.876$). There was no significant difference in the results obtained from the simple three-step scoring and the Dubowitz method (Figure 1a, b).

2. Applicability by personnel with varying degrees of experience and training, and correlation of results obtained:

The correlation of the results obtained by neonatologists, residents and nurses using this method is quite high: neonatologists $r = 0.945$, residents $r = 0.941$ and nurses $r = 0.894$ (Figure 2). There was no significant difference between their results.

3. Predictive values of individual criteria:

As can be seen in Figure 3, the external characteristics of the infant are more important for determining gestational age than the neurological criteria. Of the external characteristics in this method, facial appearance has the highest predictive value. The total score of assessment according to the new method was $r = 0.94$.

4. Superiority of the method in cases with fetal malnutrition:

Figure 4 shows the comparative results obtained by the three-step method and Dubowitz's method in determining gestational age in cases with fetal malnutrition (lower than the 10th percentile for gestational age according to Lubchenco's intra-uterine growth chart⁹). The gestational age determined by the simple three-step method correlates better with known dates ($r = 0.874$) than does the Dubowitz method ($r = 0.689$).

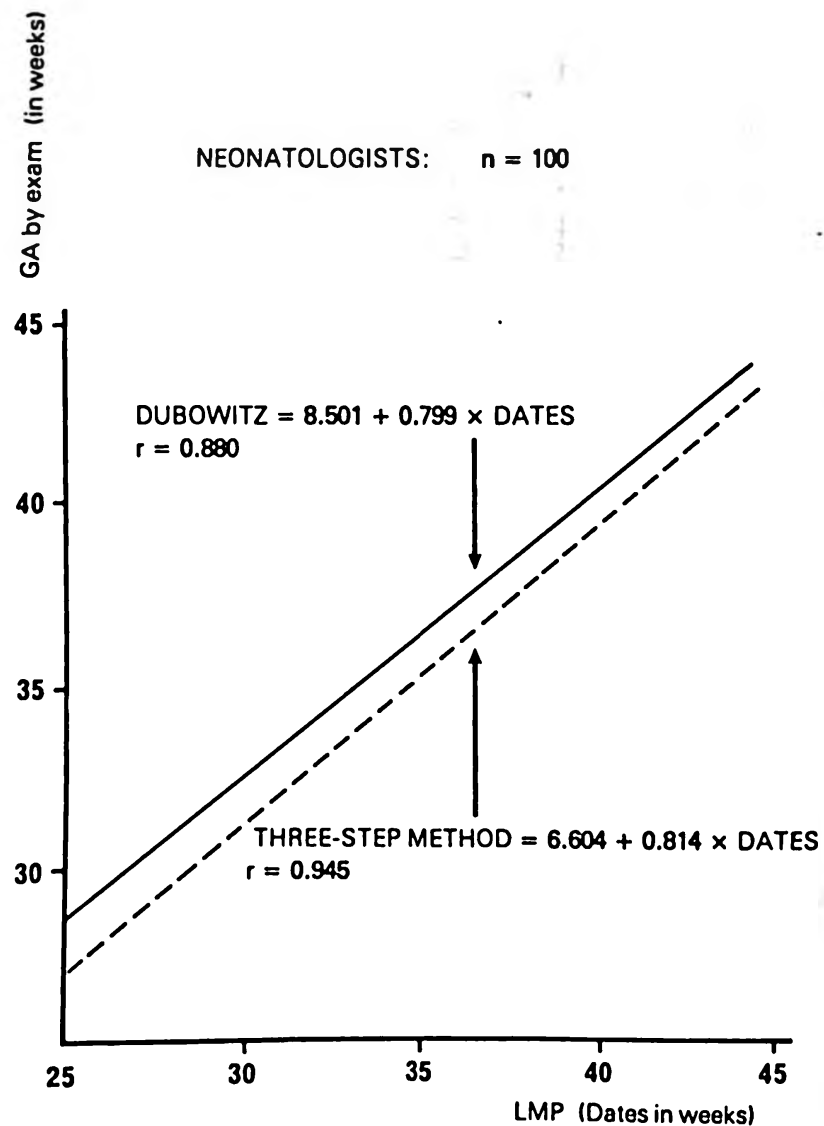


Figure 1a.

Correlation of the two scores with the gestational age calculated from the last menstrual period of the mother (n = 220): examination carried out by neonatologists.

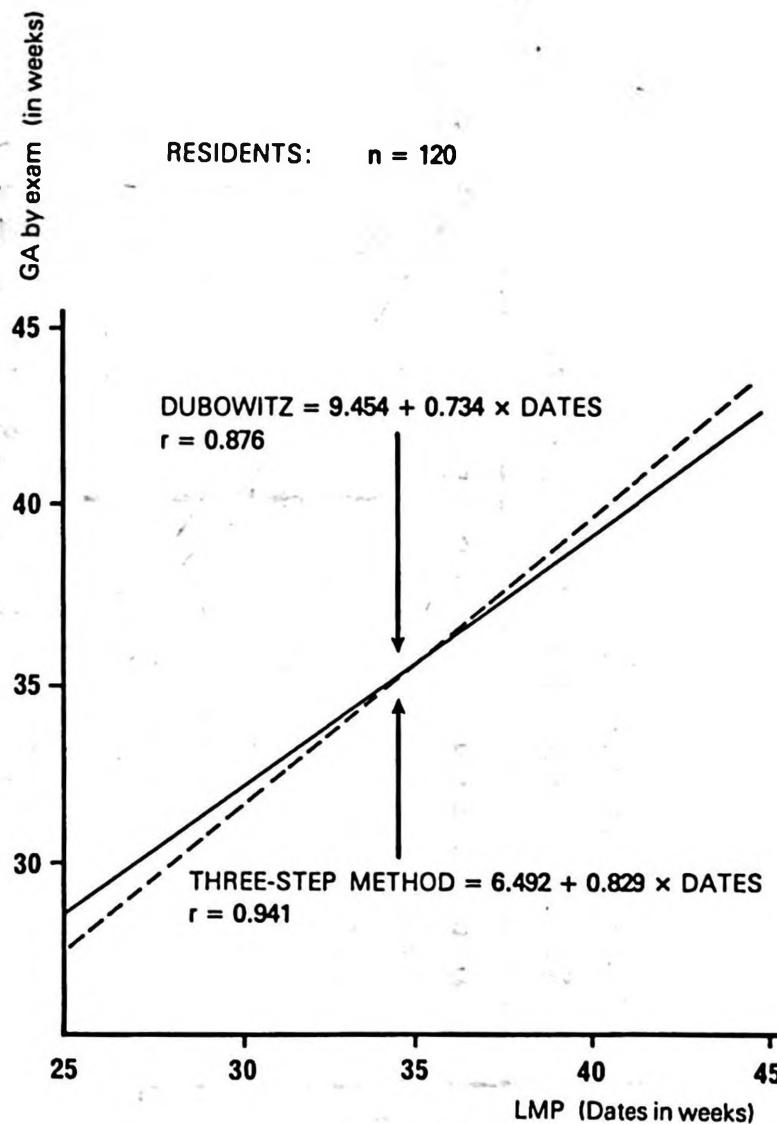


Figure 1b.

Correlation of the two scores with the gestational age calculated from the last menstrual period of the mother (n = 220): examination carried out by residents.

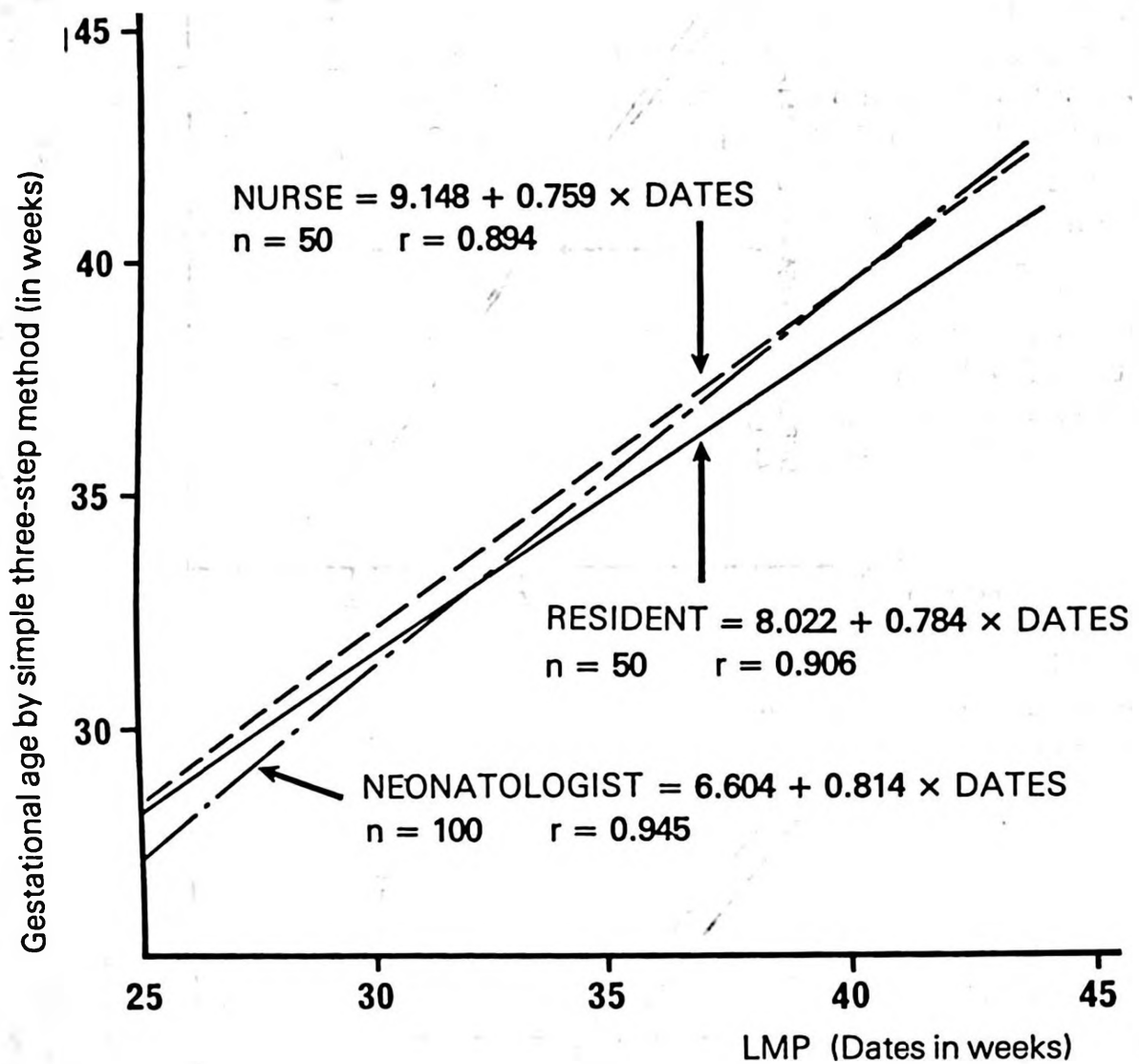


Figure 2

Correlation of results between neonatologists, residents and nurses in the determination of gestational age.

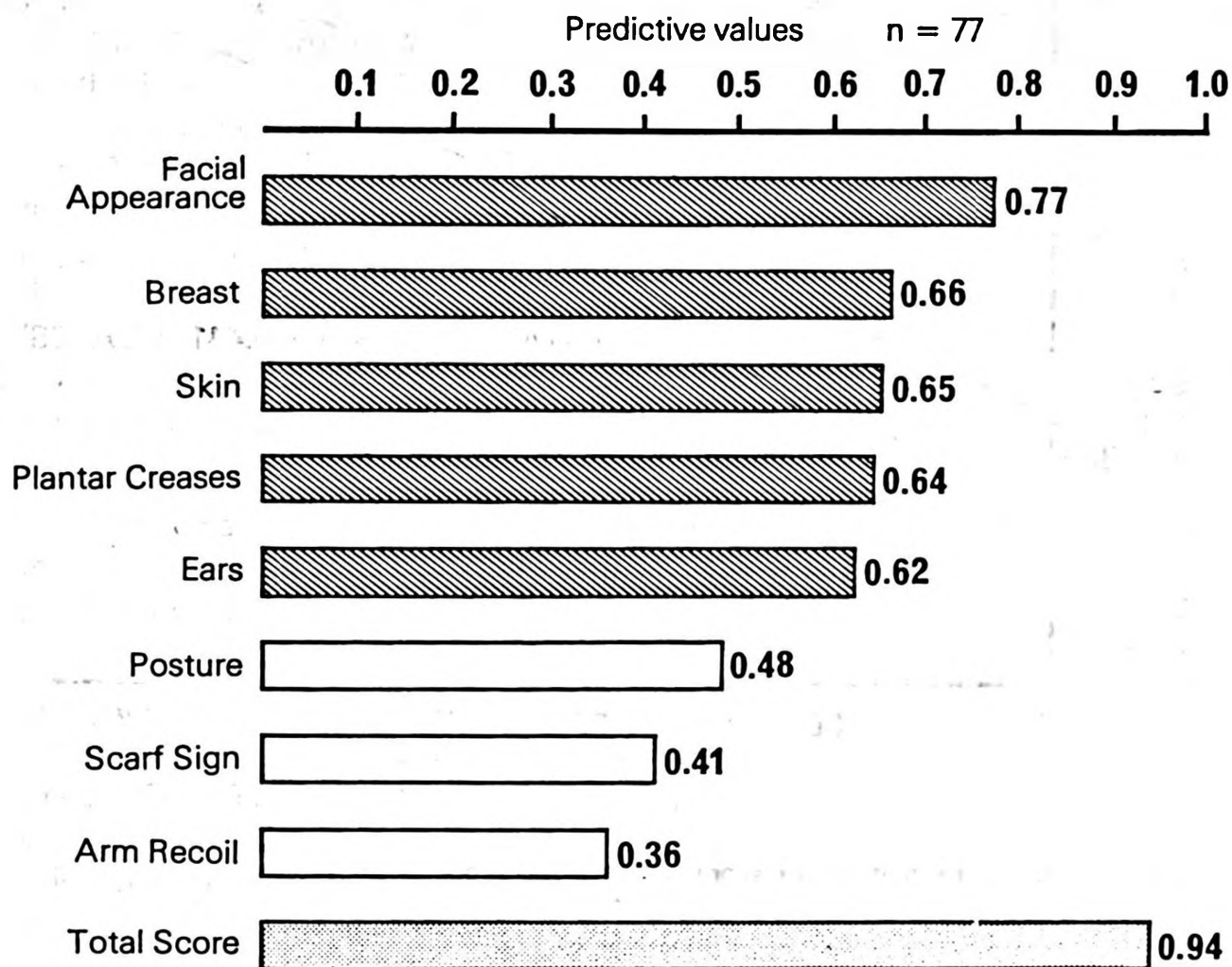


Figure 3

Predictiveness of individual criteria when compared with known dates ($n = 77$).

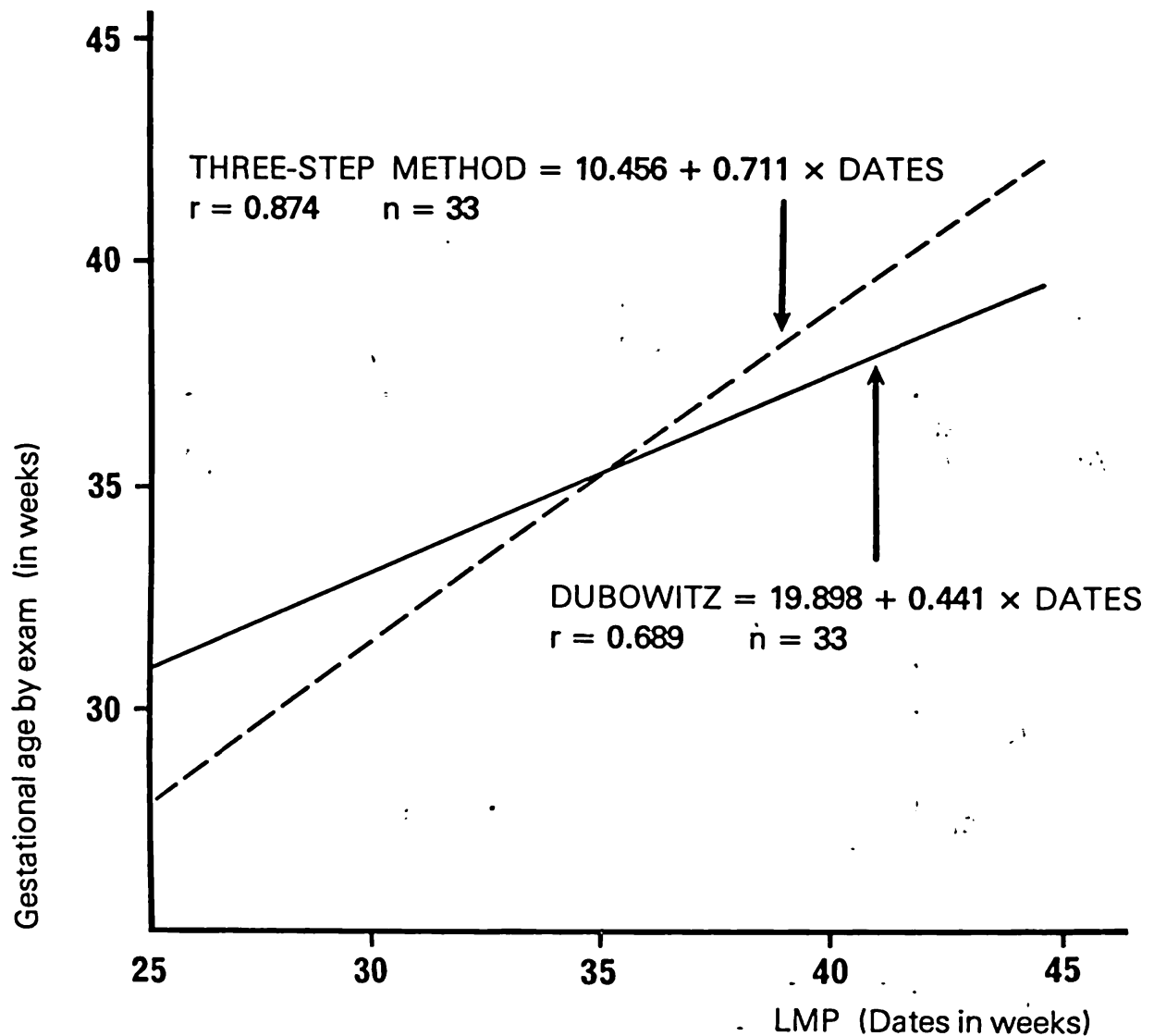


Figure 4

Comparison of the two scores with the gestational age based on dates
 in cases with fetal malnutrition.

Discussion

It is known that external characteristics give a better index than neurological criteria in determining gestational age⁴. This point is also reflected in the results obtained from this study (Figure 3). However, babies born before 34 weeks of gestation must be scored neurologically, since appreciable neurological changes occur between 26 and 34 weeks of gestation and external characteristics are less evident during this early period. For this reason, scoring systems consisting only of external characteristics are undesirable⁸.

Some of the commonly used neurological criteria, such as head lag, may reflect the well-being of the infant rather than the maturation of gestation. Another difficulty in the use of head lag occurs with babies under therapy for the respiratory distress

syndrome (RDS), as usually the head is covered with a hood or respirator. Because of this difficulty, this criterion, which was present in our preliminary report¹⁰, was omitted in the current study.

It is difficult to describe the facial appearance according to stage of maturation at some stages. However, this criterion can be described more easily at early and late gestational ages and shows considerable differences between infants with malnutrition and prematurity. Because of this, it was felt that facial appearance can be a good index in determining gestational age, and it was included as a scoring criterion for the first time in this method. Facial appearance was shown to have a higher predictive value in estimating gestational age than the other criteria used (Figure 3, $r = 0.77$) and is especially useful in differentiating infants with fetal malnutrition from prematures. Infants with fetal malnutrition have a very distinct facial appearance (such as well-shaped face, alertness and wrinkles, etc.) which is quite different from the dull-looking facial appearance of prematures of the same size. Because of this facial appearance, malnourished infants receive higher marks with the three-step scoring system (Table I). This results in increased accuracy in estimating gestational age in infants with fetal malnutrition (Figure 4, $r = 0.874$).

Depressed infants can also be examined using this method. Although the neurological performance of the depressed infant is poorer than that of the healthy infant, the scoring system takes this into consideration by giving the depressed infant more points for the same performance (Table II).

In the present scoring system, external criteria carry the weight of the system, with neurological support. This point allows us to use this method in neurologically depressed infants and gives us a chance to apply it for a longer time after birth, since external criteria do not change much during this period. Although the examinations reported here were carried out between the first 24 and 30 hours of life, it is believed that the present scoring system can be applied until 3 days of life without affecting the final results.

After a long trial, it was concluded that a combination of both types of criteria (external and neurological) give an improved result for the estimation of gestational age ($r = 0.945$ by neonatologists, $r = 0.941$ by residents and $r = 0.894$ by nurses) (Figures 1, 2).

There was also a good correlation between the results obtained from this method by different categories of staff members of the intensive care unit, namely by neonatologists, residents and nurses (Figure 2). This again shows the simplicity in application of the three-step scoring system. These results encouraged us to believe that the method can be applied even by midwives at the field level.

Besides accuracy ($r = 0.945$), the distinct advantages of this three-step scoring system are as follows:

1. It involves minimal handling of the infant and can even be used in babies undergoing therapy for RDS.
2. It can be applied quite easily to depressed and very small premature infants.
3. A new external criterion, facial appearance, gives the system a distinct advantage over the other scoring systems in identifying fetally malnourished infants ($r = 0.874$, Figure 4).
4. It can be performed within one minute.
5. Because of its simplicity, the method can be applied with the same accuracy by various categories of personnel in the neonatal unit (neonatologists, residents, nurses) despite varying degrees of experience.

Summary

A new, simple three-step method for determining gestational age is presented. The usefulness of facial appearance, as a new criterion for differentiating infants with fetal malnutrition from prematures, is emphasized.

Besides the accuracy of this method ($r = 0.945$), simplicity in application, good correlation of results obtained by different members of the neonatal unit and other advantages are discussed.

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